

Application No. 10/038,003

Page 3 of 11

IN THE CLAIMS

Please replace the claims in the present application with the following claim listing:

1-41. (canceled).

42. (currently amended) A method of processing data with a set of Turbo Codes derived from a universal constituent code, wherein the data is comprised of at least one information block, the method comprising the steps of:

encoding a signal at a first and second encoder using a universal constituent code, the first encoder and the second encoder each producing a plurality of parity bits for each information block; and

puncturing the respective at least one parity bit at each encoder with a puncturing pattern that provides a reduced signal-to-noise ratio loss compared to other possible equivalent-rate puncturing patterns;

~~A method according to claim 41,~~ wherein the universal constituent code is a rate 1/2 constituent code having a transfer function:  $G(D) = [1, (1+D+D^3)/(1+D^2+D^3)]$ , where D denotes unit delay in presentation of data bits to an encoder.

43. (previously presented) A method according to claim 42, wherein the puncturing step comprises alternately puncturing the parity bits between the first and the second encoder.

44. (previously presented) A method according to claim 42, further comprising the step of transmitting all the parity bits resulting from the puncturing step at the first and second encoder.

Application No. 10/038,003

Page 4 of 11

45. (currently amended) A method of processing data with a set of Turbo Codes derived from a universal constituent code, wherein the data is comprised of at least one information block, the method comprising the steps of:

encoding a signal at a first and second encoder using a universal constituent code, the first encoder and the second encoder each producing a plurality of parity bits for each information block; and

puncturing the respective at least one parity bit at each encoder with a puncturing pattern that provides a reduced signal-to-noise ratio loss compared to other possible equivalent-rate puncturing patterns;

~~A method as claimed in claim 41~~, wherein the universal constituent code is a rate 1/3 constituent code having a transfer function:  $G(D) = [1, (1+D+D^3)/(1+D^2+D^3), (1+D+D^2+D^3)/(1+D^2+D^3)]$ , where D denotes unit delay in presentation of data bits to an encoder.

46. (previously presented) A method according to claim 45, wherein each of said first and second encoder produce first and second parity bits; and

wherein a rate 1/2 Turbo Code is formed by transmitting half of said first parity bits produced by said first encoder and half of said first parity bits produced by said second encoder.

47. (previously presented) A method according to claim 45, wherein each of said first and second encoder produce first and second parity bits; and

wherein a rate 1/3 Turbo Code is formed by transmitting said first parity bits produced by said first encoder and said first parity bits produced by said second encoder.

Application No. 10/038,003

Page 5 of 11

48. (previously presented) A method according to claim 45, wherein each of said first and second encoder produce first and second parity bits; and

wherein a rate 1/4 Turbo Code is formed by transmitting said first parity bits produced by said first encoder, half of the second parity bits produced by said first encoder, half of said first parity bits produced by said second encoder, and the second parity bits produced by said second encoder.

49. (currently amended) An apparatus adapted to perform the method of one of ~~claims 41 to 48~~ claims 42-48.

50. (canceled)

51. (currently amended) A method of processing data with a set of Turbo Codes derived from a universal constituent code, wherein the data is comprised of at least one information block, the method comprising the steps of:

encoding a signal at a first and second encoder using a universal constituent code, the first encoder and the second encoder each producing a plurality of parity bits for each information block; and

determining a sequence of bits output as a result of said encoding step to transmit that provides a reduced signal-to-noise ratio loss compared to other possible equivalent-rate puncturing patterns;

~~A method according to claim 50,~~ wherein the universal constituent code is a rate 1/2 constituent code having a transfer function:  $G(D) = [1, (1+D+D^3)/(1+D^2+D^3)]$ , where D denotes unit delay in presentation of data bits to an encoder.

52. (previously presented) A method according to claim 51, further comprising the step of transmitting all the resulting parity bits produced by the determining step at each of said first and second encoder.

Application No. 10/038,003

Page 6 of 11

53. (currently amended) An apparatus adapted to perform the method of one of ~~claims 50, 51, or 52~~ claims 51 or 52.

54. (previously presented) A method of encoding signals, the method comprising:

generating a first set of parity bits using a constituent code based on received information bits;

interleaving the information bits;

generating a second set of parity bits using another constituent code based on the interleaved information bits, wherein the constituent codes are universally adapted to optimally accommodate a variety of interleaver depths and Turbo code rates;

puncturing the sets of parity bits according to one of the code rates; and

outputting a coded signal based on the punctured parity bits.

55. (previously presented) A method according to claim 54, wherein the constituent codes exhibit a rate of 1/2 and have a transfer function of  $G(D) = [1, (1+D+D^3)/(1+D^2+D^3)]$ , D denoting unit delay in presentation of the information bits for generation of the parity bits.

56. (previously presented) A method as claimed in claim 54, wherein the constituent codes exhibit a rate of 1/3 and have a transfer function of  $G(D) = [1, (1+D+D^3)/(1+D^2+D^3), (1+D+D^2+D^3)/(1+D^2+D^3)]$ , D denoting unit delay in presentation of the information bits for generation of the parity bits.

57. (previously presented) A method according to claim 54, further comprising:

selecting a candidate system rate for the constituent codes;

evaluating performance of all possible Turbo code rates formed by the constituent codes according to a first interleaver depth and a plurality of test puncturing patterns;

Application No. 10/038,003

Page 7 of 11

determining a subgroup of candidate pairs of constituent codes, wherein other interleaver depths are applied to the subgroup; and

determining the universal constituent codes from the subgroup yielding best performance for the interleaver depths.

58. (previously presented) A computer-readable medium bearing instructions for encoding signals, the instructions, being arranged, upon execution, to cause one or more processors to perform the method of claim 54.

59. (previously presented) An encoder comprising:  
a first constituent encoder configured to generate a first set of parity bits using a constituent code based on received information bits;  
an interleaver configured to interleave the information bits;  
a second constituent encoder configured to generate a second set of parity bits using another constituent code based on the interleaved information bits, wherein the constituent codes are universally adapted to optimally accommodate a variety of interleaver depths and Turbo code rates; and  
logic for puncturing the sets of parity bits according to one of the code rates, wherein a coded signal is output based on the punctured parity bits.

60. (previously presented) An encoder according to claim 59, wherein the constituent codes exhibit a rate of  $1/2$  and have a transfer function of  $G(D) = [1, (1+D+D^3)/(1+D^2+D^3)]$ ,  $D$  denoting unit delay in presentation of the information bits for generation of the parity bits.

61. (previously presented) An encoder as claimed in claim 59, wherein the constituent codes exhibit a rate of  $1/3$  and have a transfer function of  $G(D) = [1, (1+D+D^3)/(1+D^2+D^3), (1+D+D^2+D^3)/(1+D^2+D^3)]$ ,  $D$  denoting unit delay in presentation of the information bits for generation of the parity bits.

Application No. 10/038,003

Page 8 of 11

62. (previously presented) An encoder according to claim 59, wherein a candidate system rate is selected for the constituent codes, and performance of all possible Turbo code rates formed by the constituent codes is evaluated according to a first interleaver depth and a plurality of test patterns, a subgroup of candidate pairs of constituent codes being determined, wherein other interleaver depths are applied to the subgroup, and the universal constituent codes are determined from the subgroup yielding best performance for the interleaver depths.

63. (previously presented) A method of decoding encoded signals, the method comprising:

receiving an encoded signal encoded by a Turbo encoder, a first set of parity bits being generated using a constituent code based on received information bits, a second set of parity bits being generated using another constituent code based on interleaving the information bits, wherein the constituent codes are universally adapted to optimally accommodate a variety of interleaver depths and Turbo code rates, and the sets of parity bits are punctured according to one of the code rates; and

iteratively decoding the encoded signal to output a decoded signal based the universal constituent codes.

64. (previously presented) A method according to claim 63, wherein the constituent codes exhibit a rate of 1/2 and have a transfer function of  $G(D) = [1, (1+D+D^3)/(1+D^2+D^3)]$ , D denoting unit delay in presentation of the information bits for generation of the parity bits.

65. (previously presented) A method as claimed in claim 63, wherein the constituent codes exhibit a rate of 1/3 and have a transfer function of  $G(D) = [1, (1+D+D^3)/(1+D^2+D^3), (1+D+D^2+D^3)/(1+D^2+D^3)]$ , D denoting unit delay in presentation of the information bits for generation of the parity bits.

Application No. 10/038,003

Page 9 of 11

66. (previously presented) A method according to claim 63, wherein a candidate system rate is selected for the constituent codes, and performance of all possible Turbo code rates formed by the constituent codes is evaluated according to a first interleaver depth and a plurality of test puncturing patterns, a subgroup of candidate pairs of constituent codes being determined, wherein other interleaver depths are applied to the subgroup, and the universal constituent codes are determined from the subgroup yielding best performance for the interleaver depths.

67. (previously presented) A computer-readable medium bearing instructions for decoding encoded signals, the instructions, being arranged, upon execution, to cause one or more processors to perform the method of claim 63.

68. (currently amended) A ~~receiver~~ transmitter for processing coded signals, the receiver comprising:

a Turbo encoder configured to encode a signal at a first and second encoder using a universal constituent code optimized based on a plurality of interleaver depths and Turbo code rates, the first encoder and the second encoder each producing at least one parity bit, the Turbo encoder being further configured to determine a sequence of bits to transmit based on the universal constituent code; and

a modulator configured to modulate the sequence of bits according to a predetermined modulation scheme.

69. (canceled)